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**KINETIC ENERGY SPECTRUM OF TURBULENT PLASMA DENSITY FLUCTUATIONS
IN A TOKAMAK ^{*)}**^{1,2,3}Kukushkin A.B., ¹Kulichenko A.A.¹National Research Center «Kurchatov Institute», Moscow, Russia, Kukushkin_AB@nrcki.ru,²National Research Nuclear University «MEPhI», Moscow, Russia³MIPT (NRU), Moscow, Russia.

Previously [1, 2] it was shown that plasma density fluctuations observed in the T-10 tokamak using cross-correlation reflectometry of EM waves [3, 4] can be of turbulent origin. The decay rate in the Lévy distribution for the probability of the free path of density fluctuations, found in the formalism of integro-differential equations of nonlocal transfer of fluctuations in the “Lévy walk” type regime, turned out to be close to its analogue in Richardson’s empirical law [5] for hydrodynamic turbulence of gases and liquids. In [1, 2], a universal description of the connection between the observed Quasi-Coherent Mode [3, 4] in the spectrum of scattered EM waves in the plasma of the T-10 tokamak and the process of the Mandelstam-Brillouin scattering type was also obtained.

In this work, the following results were obtained.

1. A general analytical result is obtained for the spectrum of specific kinetic energy of density fluctuations of a turbulent medium in the model of stationary quasi-homogeneous (not necessarily isotropic) hydrodynamic turbulence. The spectrum has a universal dependence on the distribution function over the free path of plasma density fluctuations in a given quasi-homogeneous medium. Since the specified spectrum of specific kinetic energy is directly related to the observed spectrum of scattering of EM waves on density fluctuations, the characteristic parameters of the kinetic energy of density fluctuations can be reliably determined from the scattering spectrum.

2. The formula [1, 2] for the cross-correlation function of reflectometric probing of density fluctuations of a quasi-homogeneous turbulent medium is generalized for the case of non-isotropy of the medium. This result covers the case of plasma in a uniform magnetic field and is applicable to cross-correlation measurements in a tokamak over, for example, a few centimeters in the plasma, far from the periphery of the plasma column with the minor radius of ~30 cm.

3. The spectrum of the specific kinetic energy of plasma density fluctuations was calculated based on experimental data [4] from the T-10 tokamak and compared with the corresponding Kolmogorov spectrum [6] for stationary homogeneous hydrodynamic turbulence. It is shown that the energy spectrum is close to the Kolmogorov one in the wing of the spectral line, called the Quasi-Coherent Mode [3] and corresponding, as shown in [1, 2], to the scattering of probing radiation on density fluctuations moving along the minor radius of the plasma column (i.e. across a strong magnetic field) in both directions - inward and outward of the plasma column - with the average speed of $\sim 10^4\text{--}10^5$ cm/s.

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